

Gaston (J. McF.)



EXPLANATION OF THE PATHOLOGY AND THERAPEUTICS OF THE DISEASES OF THE NERVE CENTRES, ESPECIALLY EPILEPSY.

BY J. MCF. GASTON, M. D., ATLANTA, GA.

Preliminary to a consideration of the pathology and therapeutics of the nervous system, the general results of former investigations as to the structure and functions of its different elements must be recognized. The great cardinal distinction of the cerebro-spinal and ganglionic ramifications with the delicate interlacing in their minute peripheral branches, co-operate for developing that nerve power which is transmitted to all the organs of the body.

The properties of the motory and sensory spinal nerves, the reflex functions of the spinal cord, the organic developments of the great sympathetic, and their co-ordination in harmonizing all the functions of the physical organism, afford the chief characteristics of the general nervous system.

Physiologists are for the most part agreed as to the main doctrines touching the important modifications impressed upon the organization by this complex force of the different kinds of nerves, but investigation is still progressing in regard to the various capacities of the subdivisions of the nervous system. A rational and scientific explanation of the mutual dependence of the principal organs has been attained, and a clear insight as to the performance of most of the organic functions has been gained by the carefully conducted experiments of practical physiologists, while advances have been made in vital phenomena by clinical observation. The conflicting views of those who have made

the most thorough investigations in experimental physiology during these latter years, render the results of clinical observation important in the relations of the nervous system to the dependent organism, and to the performance of the various functions concerned in the harmonious development of the whole frame. While one set of experimenters recognize the medulla oblongata and spinal cord as the chief sources of "the nerve influence in the tissues," another deduces from investigations in the physiological laboratory that many phenomena believed to be produced by the agency of the nervous system, may be really independent of it. It is held by the latter that "the vaso-motor nerves exert their influence profound and extensive, but the tissue elements which they control have also a power of independent action."

The excito-secretory function of the nervous system which plays so important a part in the nutrition of the body, and its counterpart, that presides over the excretory processes of the different organs, are to some extent independent of the direct operation of the general nervous system, yet so associated with the distribution of the ganglionic nerves as to receive a modification from this source. There is a delicate interchange of nerve power between the spinal and organic ramifications to the internal organs, which co-operates with the peripheral distribution of nerve fibrils in the development of vital force. This harmonious result ensues from the operation of the nerve-centres, and as the current which flows along the electric wire requires that the battery shall be in good order, so it is requisite that their energy shall be preserved.

The experiments of a distinguished physiologist have recently confirmed the principle inculcated as to the role of the peripheral nerves, by presenting the phenomena of inhibition in remote parts, from the local application of

chloroform. It is thus shown that "a remote action takes place through the skin on the nervous system," and it is claimed that "it is the first occasion in which the loss of muscular excitability resulting from a remote irritation has been observed."

It is clear that the reflex manifestations of the nervous system do not suffice to explain the various sympathies and modifications which operate between the different regions of the body. There is a very peculiar potency in the intricate association of the various parts of the human organization, which must be recognized for the solution of the physiological problem; and demands consideration in the study of the reciprocal disturbances of the organs with their pathological sequences, while it cannot be overlooked in the application of remedies.

Facts observed in treating a great variety of diseases have confirmed the results of experiment as to the great importance to be attached to this element of energy on the part of the nervous development, which connects the surface with the interior structure. In deducing from such facts, the grand motor-power which is operative in the mutual relations of the dependent parts of the organization, there is afforded a satisfactory explanation of the objective developments of physiology and pathology, and the subjective capacity for therapeutic applications. For a satisfactory comprehension of the correlation of the nerves and capillaries and their relations to the nerve centres, we must look to a property of the nervous system, which may be defined as the excito-dynamic element, and through their mutual dependence and reciprocal reaction the whole train of local and general disturbances may be explained.

I am thoroughly convinced of the intimate relations of the capillary and nerve fibrils with the vital functions, and

it strikes me forcibly that sufficient stress has not been placed upon these so called sympathies in attempting to fathom the depths of pathological diagnosis. In consideration of the data afforded by the arrangement of the minute blood-vessels and their dependence upon the almost infinitesimal ramifications of fibrillas of nerves from the different systems, it must be inferred that the condition of the tissues supplied by them is subject to modification from the general innervation. Such being the case, and it being ascertained that a letting-down of the nervous energy uniformly precedes the appearance of disease, it is fair to attribute this local condition to the effect of the impaired nerve-power upon the capillaries. It has been established by the investigation of recent observers that the arrest of the function of contractility in the capillaries is the constant attendant of congestion, which is the immediate precursor of inflammation.

We know by experiment that the division of that branch of the sympathetic which extends to any part, thus inducing a paralysis of its function in that part, leads to dilatation and consequent engorgement of the respective capillaries.

We are therefore prepared to infer that, from some unknown cause, the nervous distribution of the regions involved loses its vitality, or has it materially impaired, so that by lack of the tonifying influence upon the small blood-vessels, and especially the capillaries, there is a stasis of the blood, and eventually a disorganization in the cellular tissues, implicating the adjacent textures. To appreciate what is passing in the deeper-seated parts, and what alterations must ensue for the termination in suppuration, it must be considered that there is an arrest of the free circulation of blood in the subjacent structure, dependent, doubtless, upon a paralysis of the vital functions of the minute nerve fibrils that accompany the capillaries of these textures

The desideratum for a proper study of the disorders of the nervous system is an adequate knowledge of the physiology of the same, or in other words, a true conception of the normal performance of its functions.

In the healthy physical organization all the mutually dependent parts harmonize in their execution of the offices suited to the respective organs of the body; and the nerve power that is requisite for respiration, digestion, and assimilation differs to some extent in quality, but there is good reason to believe that the element of quantity or degree has much to do in the regular action of the various divisions and sub-divisions of the physical framework that constitutes the human body.

The capacity for movement, the sensibility to pain, the power of appropriating nutriment, the endurance of active exercise which causes wear and tear of the vital force, all depend upon special supplies of energy through the different attributes of the nervous system; and our inquiry as to the pathology and therapeutics of the various departments, involves a comprehension of the operation on the part of the nerves as a whole and in detail.

It is evident that the nerve centres are essential for the propagation of any impression upon the superficial distribution of nerves, through a connection with these and with the parts to which the influence is extended. In the experiments of Brown-Sequard demonstrating the arrest of function by local anaesthetics, this intervention of nerve centres is illustrated: "It is the phrenic nerve and half of the diaphragm of the opposite side to that of the application of the chloroform that thus becomes inhibited and paralyzed; not only as regards their action, which depends on nerve cells, but also their property of tissue—the muscular excitability having disappeared." The great reach

of this minute and intimate relation of the capillaries and nerve fibres, through the nerve centres, in the "arrest of the exchanges" is shown in the diversified forms of disturbance at remote points from that upon which the primary impression is made, and from which by its nervous connection the inhibitory effect is transmitted to the tissues.

There is no doubt that medicinal agents in many cases enter the circulation and produce their appropriate effects upon different organs by absolute contact with the secretory apparatus, yet there are numerous instances in which the result does not depend upon such a circuitous route for the development of their action. If it can be shown that effects upon the vital functions ensue from external impressions, independent of the absorption of any substance, it is clear that such results may be anticipated in similar applications under like circumstances. All the class of revulsions, including the sudden impression of extreme heat and cold, upon circumscribed portions of the cutaneous surface, depend doubtless upon the reflex property of the nervous system for their effect.

This sudden energy cannot depend upon any other link of association than the interchange effected by the action and reaction of the nerves and nerve centres. While the circulation of the blood is a pre-requisite to any exhibition of power on the part of the nerves, no extension of the impression in this case depends upon the veins or the arteries which respectively convey the blood from and to the surface with which the agent is brought into contact.

It is held by the advocates of sanguiniferous communication that in the cases which indicate an influence of medication upon the nervous system, the effect is developed solely through the transmission of the medicinal agent to the nerve centres by the blood. But while the nerve cen-

tres are essential to the due influence of agents upon the nervous system, this does not in any way militate against the view that impressions are transmitted through a nervous connection with the peripheral branches. The close sympathy of the capillary plexus with the internal ganglionic system, substantiates their reciprocal action and reaction in the manifestation of the effects of external impressions upon the body.

The vaso-motor system of nerves is an outgrowth of the interlacing of the cerebro-spinal and great sympathetic nerves, and presides more especially over the contractility of the coats of the blood vessels. Hence it occurs that in cases of paralysis, implicating the motor and sensory branches of the spinal nerves, the circulation of the blood is not materially affected. But when the vital force becomes involved through the organic nervous system, it is found that the flow of the blood is impeded or accelerated from depressing or stimulating agencies, which operate upon the ganglionic nerve-centres, and whose influence is propagated to the vaso-moter nerves.

The co-ordination of the peripheral distribution of the nerves with the nerve-centres, pertaining to animal or organic functions, is a pre-requisite for health ; and every departure from this, whether external or internal, becomes disease. Let the source of such impressions be what it may, we are concerned only with the effects as developed in special derangements, and as the escar resulting from a coal of fire or a portion of frozen solidified carbonic acid gas, placed upon the skin, presents very similar characteristics, so the peculiar consequences of impressions on the nervous system, from apparently opposite influences, have a striking resemblance. A neuralgia, for instance, may be induced by very different causes, yet still it is the same disorder

of the nerve affected, and requires like treatment as if from a common origin. Not that all the entire class of neuralgias are identical in their nature or degree, and hence amenable to the same remedy, for there are numerous instances of departure from this uniformity, yet the fact holds good, that like effects frequently ensue from unlike causes, which demand like treatment in the correction of the disordered innervation. As a counterpart to this it is observed that similar causes produce very different effects upon the nervous system, so that according to the particular region that sustains the impression the consequences vary widely. What are ordinarily considered as special diseases, developed in the several organs, are generally to be attributed to a primary alteration in the nervous supply to the respective parts, and may be a legitimate sequel from a remote origin operating diversely in the parts.

It is generally held that some untoward impression from without induces changes within the body which lead to the functional derangements primarily, and that the organic disturbance ensues in consequence of the perverted action.

There is such an intimate relation between the capillary vessels and minute nerve fibrils of the skin and the internal viscera by the action of the excito-dynamic function of the nervous system that any irregular local impression upon a particular portion of the cutaneous investment of the body is soon brought to bear upon some corresponding internal organ, and induces a proportional derangement subsequently of the general system. A want of the proper equilibrium in the distribution of nervous energy to different portions of the organization is the first link in the chain of abnormality. Then local capillary engorgements ensue as secondary phenomena, while visceral congestions lead to excitation and irritation of the internal organs. This influence

of the vitiated action extends ultimately to remote parts supplied with fibrous and serous tissues, not as a constituent but as a result of the disease.

Under such conditions the "proteinous alimentary principles" become involved in the perturbation, and hence the development of fever is accompanied by the transforming of the albuminous and gelatinous elements into fibrine.

The intimate association of the minute distribution of the nerve fibrils and capillaries with the primordial elements of the tissues favors the idea that fibrinous depositions may be eliminated through agents operating through the nervous system, and the supposed alterative effects of medicines may ensue from nerve agency.

When we come to understand precisely the nature of the influence prevailing over the several organs through the distribution of nerves to the same, as a preliminary element of disorder in their functions, a great advance may be expected in the prophylactic regulations which constitute hygienic laws. A due consideration of the minute ramifications of the multifarious kinds of nerve fibres which permeate the viscera, and the various tissues of the organization, throws much light upon the pathology of all those diseases springing from changes in the nerve element of the several organs of the body. It is evident that any deterioration of the innervation must pave the way to other disturbances, and the incipient stages of most diseases indicate a primordial atony of the nervous branches distributed to the affected part. In other words the trouble comes through the nervous system, and consequently a corrective should be addressed to the nervous system. A vast array of facts can be brought to illustrate the preliminary depression of nerve-power as the primary element of trouble in the diversified forms of disease, and the clinical experiences of all

practitioners furnish sufficient data upon which to base the conclusion that remedies applied at this stage, solely with reference to their control over the nervous system, suffice to arrest the development of further disorder in the organization. Should the train of sequences not be cut short by such means, it then becomes necessary to adopt measures of a different order and to combat structural changes resulting from the primary nerve-lesion.

The subcutaneous areolar tissue is so intimately connected with the internal organs by the correlation of the capillaries and nerve fibrilles, as to afford a most important medium for the introduction of medicinal agents. The influence of medication is manifested more promptly by this channel, whether by absorption or by direct transmission of the nerves than is practicable through the stomach, and this line of approach to the citadel of life affords us abundant evidence of the telegraphic connection of the great nerve centres with the cutaneous outposts.

An exact understanding of the intimate relations of the nerve fibres to the capillaries and their joint influence upon the nerve centres through which the various organs become affected, implies a link of communication between the centripetal and centrifugal forces of the animal economy. This consists in a propagation of nerve power in some manner independent of the brain and spinal marrow, to which a clue is afforded by the experiments on the "arrest of the exchanges"; and the inhibition of remote parts by the local application of an anæsthetic goes very far towards demonstrating an independent action of the peripheral plexus of nerves associated with the capillaries. There is a general development of energy coexistent with the distribution of the nerve fibrils and the capillaries to the surface of the body, that is extended by a nervous link to the mucous and

serous membranes and to other tissues of the organism, and this can only be through the intervention of the ganglionic nerve centres. The question for elucidation is no longer as to the fact of this reciprocal relation of parts, but we have to consider the true sphere of action and reaction between these various elements growing out of their special vital capacities. It is requisite that pathologists shall define the precise channel of communication through the nervous ramifications by which impressions are conveyed from one part to another, not in the line of the ordinarily recognized tract of nerves, when the ultimate point reached is shown clearly by their effects. A proper explanation of the physiological relation of the nerve fibrils and capillaries to the normal and regular performance of the functions of the different organs, must conduce to a better understanding of their pathological conditions, and the great desideratum is the establishment of the chain of connection through the nerve centres. The constant operation of impressions through a link of communication, independent of the afferent and efferent spinal nerves, is a matter of clinical observation and leads us to infer the existence of these distinct nerves or interlacing of the ganglionic branches connecting the outer and inner parts of the body.

It is a well known fact that in hemiplegia or in paraplegia involving the motory and sensory branches distributed to the affected parts, that the circulation is maintained with the temperature in like manner as in the sound members, demonstrating their independence of the cerebro-spinal nerves; and while the vaso-motor system presides over these functions to a large extent, there is observed in lesions of the spinal marrow, resulting in complete paralysis of the lower extremities, at times an elevation of the temperature above the heat of other parts of the body, and a capacity to

resist an exposure to the lower temperature of the surrounding atmosphere, which leads to the inference that a power of developing extra heat exists in those parts deprived of the influence of the cerebro-spinal system of nerves. I have had an opportunity of noting this result in a case of fracture of the spinal column, when the hands became chilled by the exposure, and the lower extremities maintained heat.

On the other hand, as a counterpart to this, it is often observed, that the temperature of the extremities becomes much reduced below that of the body under the operation of vital depression, or causes operating on and through the organic nerves, while sensibility and motion in these parts remain unimpaired. This occurs in the cold stage of intermittents, and in some nervous disorders, in a very striking degree, but is especially noticeable in cholera and in colligative diarrhoea attended with great prostration.

In view of these phenomena it is clear that a dynamic element exists in the nervous system of which physiologist have not taken any special notice, and this property of the ganglionic nerve-centres I would designate as excito-dynamic. It is something quite distinct from anything heretofore attributed to any division of the nervous system, and gives us a clue to the explanation of the pathology and therapeutics of the nervous system.

I would advert to the tonic muscular contraction of tetanus as an indication of augmented action on the part of the nerves or an increase of the excito-dynamic element, whereas the want of co-ordination manifested in St. Vitus' dance or chorea, illustrates a deficient influx of nerve power, and the means specially adapted to their relief, respectively, are of the sedative and tonic order. If the elevation and depression of vital manifestations originating from the greater or less nerve power developed in the system be duly con-

sidered, a correct appreciation may be made of the physiological status of the organism, and a proper basis of the pathological condition will be furnished with a true guide to therapeutics.

The transmission of cutaneous modifications to the internal organs becomes in many instances a great source of disorder to the animal economy. The sympathy of one part with another in the transfer of superficial impressions to the interior organs depends upon the distribution of the peripheral nerves, and their relations to the nerve centres, which act as relay stations to disseminate the current in various directions. Thus we have a rational and scientific explanation of the different results upon which depend the various manifestations in health and disease. The local impression modifies the constituent elements of the cutaneous surface, and through the connection of the outer and inner structures by the general nervous communication a vital alteration is effected upon the internal organs.

It is a fair inference, therefore, that the immediate transmission of the hurtful influence from the stings of insects and the bites of venomous serpents does not depend upon the comparatively slow process of absorption for propagation through the circulation of the blood. A primary impression made through the capillaries upon the minute ramifications of the nerves is probably extended to the nerve centres and thence propagated, by the joint operation of the spinal and ganglionic nerves, to the whole system. But whatever may be the route of poisons that come in contact with the network of nerves and capillaries in the areolar tissue, their peculiar effects are conveyed very promptly to the other tissues and to the different vital organs, developing remarkable modifications in all the organic elements of the body.

The same speedy manifestation of their effects is noted from the introduction of medicinal agents beneath the cuticle by injections or otherwise. Instead of any local irritation, as might be anticipated from the topical application of medicinal agents, there is soon manifested a general influence upon the organization, corresponding to the special property of the article employed. This action is doubtless due in part to the conduction of the medication by the multitudinous currents setting out from the point of introduction, but should be attributed chiefly to the dynamic property of the nerves supplying the part. The effect of an inert substance, such as distilled water, upon the nervous system, even affording almost immediate relief to local pain, shows a very delicate susceptibility of the physical organism to the action of hypodermic applications, and their marked influence depends upon the direct communication of the nerve fibrils and capillaries with the nerve centres of the ganglionic and spinal systems. The notable effects of the use of dry cups, sinapism and blisters upon the surface, are likewise due to the intimate relations established through this channel of communication with the internal parts of the body. The mutual dependence of the superficial and deep-seated structure upon a dynamic element of the nervous system is very evident in some conditions of the organism, manifesting an insusceptibility to the action of irritants upon the skin. Yet when a change is effected in the vital force of the general system, normal sensibility returns to the surface, and excitement is developed in the parts where sinapism and blister had produced no effect previously. It is this element of nerve power which suffers detriment in that vital failure called shock that results from severe injuries, and there must be a partial paralysis of that property of the nervous system to which I have applied the term

excito dynamic, so that it becomes insensible to the use of stimulants for a longer or shorter period after such impression.

This underlying impairment of the vital forces resulting from concussion of the nerve centres, should always be suspected when marked prostration follows operations or extensive wounds; and the deep-seated injury to the nervous system is often such as to endanger life. The nerve element involved in this condition is referable to the organic system, and is quite distinct from any of the ordinary nervous depressions which accompany mental perturbation or casual physical derangement. It is the excito-dynamic faculty that becomes implicated, and affords quite a sufficient contra indication to any demand upon the vital energy by depletions or other depressing agencies.

Practitioners are familiar with a great variety of data illustrating the modifications of the organisms through this channel, and the nature of the special cause is propagated in an extraordinary manner for the development of specific diseases. As transient impressions leave temporary derangement, so it is found that continued application of certain agents leads to permanent results upon the system. The absorption of a virus from contact with the mucous membranes, or by insertion beneath the cuticle, develops subsequently the specific constitutional effects of the special contamination. The direct influence upon the part is not immediately perceived, but in the course of time, according to the period of incubation, an inflammation ensues locally, and from this point of irritation, in the course of another definite period, there is transmitted a peculiar disorder to the general organization, which indicates that the poison has been in operation through a definite channel to bring about this result; and thus demonstrating the reciprocal

relations between the surface and interior structure of the body.

The final result of all such impressions is not a manifestation of reflex action emanating from the excito-motor nerve centres, nor is it an exhibition of the property of the excito-secretory nerves, neither can it be traced to the vaso-motor element of the nervous system, and hence it must be referred to a nerve function distinct from these recognized attributes of the nervous system. The effect is due to a peculiar influence propagated to the organization by the excito-dynamic function of the nervous system, which operates through a definite association of the ganglionic and spinal nerves with the nerve centres, and depends upon the correlation of the nerve fibrils and capillaries with the central nervous system. It is a reasonable inference from the facts observed that structural disorders arise from a molecular change in the tissues, which is to be corrected by a generalization of therapeutic measures, and that the development of so-called nervous diseases depends to a large extent, if not entirely, upon the augmented or diminished energy of the nerve centres, calling for the use of remedies chiefly of a stimulant or sedative nature. A correct pathology of the nervous system must be based upon an adequate conception of the mode in which the efficient cause of trouble brings about the consequent alteration in the functions of the various organs, so that measures may be resorted to for correcting such disturbances by understanding properly through what channels and by what agents salutary modifications are produced upon the physical organism.

Important revelations as to the disorders of these nerve centres are afforded by very simple processes of exploration. The morbid impressions upon the nerve centres are made to a very large extent upon the network of capillaries and

nerve fibrils which enter into the composition of the cutaneous investment of the body, as well as into the structure of the mucous and serous membranes lining the various cavities or covering the various organs. They constitute the peripheral excitodynamic element of the nervous system; and when other indications may be doubtful, these manifestations of the capillary system may be relied upon for a decision. It is the outward indication of the inner working of the organism, dependent upon the correlation of the peripheral nerves and capillaries with the great nerve centres of the cerebro spinal and ganglionic nerves. The ganglionic element which has been demonstrated to exist in the plexus of nerve-fibrils that enter into the structure of the skin and other investing membranes, has doubtless an independent property in its functions corresponding in some measure to the separate action of the nerve centres in the interior organization. Facts warrant the inference, that a chemico-vital process, by the relations of these minute peripheral ganglia with the capillary blood vessels, is developed locally, and is manifested without the intervention of the general cerebro-spinal nervous system. Such being the case, it can readily be understood how impressions made upon the peripheral branches of the nerves may affect the performance of the functions of the various internal organs through the ganglionic nervous system. As the counterpart of this independent action in the superficial organism, it may be comprehended that the modification of the internal organization is shown in the varying contractility of the capillaries.

The tonicity of the peripheral nerves and capillaries is a fair index of the state of the internal nerve centres and according to the time required for the ordinary color of the skin to be completely restored to the spot upon which pres-

sure is made temporarily by the end of the finger, the vital energy of the organization may be proximately determined. The local compression expresses the blood for the time being from the capillaries, thus leaving this spot whiter than the florid surrounding surface. If the walls of the capillary tubes are relaxed from the want of tone in the minute branches of the nerves, constituting a state of congestion dependent upon debility, the return of the blood to the capillaries will of course be retarded. Should there exist, however, a super-excitation in the nerve power, the return of the blood should be quicker and the color will be restored more promptly. All the shades between stasis of the capillary circulation and the acceleration which characterizes fever, with its increased heat and florid hue of the surface, may be detected by digipressure and dynamoscopy. When these processes of examination are used with discrimination, we have a guide to the state of the forces of the system.

It has been verified by repeated observation that the intensity or feebleness of these sounds in the superficial parts of human organism depends upon an inflammatory or excited state as contra-distinguished from an anæmic or a depressed condition of the general system, and that they become thus a reliable means of determining the vital energy of the organization.

It has been further ascertained that the prompt or slow return of color to a spot pressed upon for a short time on any part of the surface, results from the vigor or weakness of the capillary circulation, affording in this way an indication of the force or debility of the nerve power propagated from the nerve-centres to the vital organism.

While means have been devised for determining the temperature of the body, the force of the blood current, and

even the intensity of muscular contraction, the author of this paper is not aware of any device other than the dynamoscope measuring the vital force of the nervous system, and he claims that by these simple modes of procedure a true criterion is presented for the use of stimulants or sedatives, that operate through the nerve-centres upon the general organization of the physical frame.

The dynamoscope has been overlooked in the grand march of progress in the diagnostic proceedings of medical practitioners, and the simple expedient of pressure with the point of a finger temporarily upon the surface has not been appreciated.

The propagation of nerve power as manifested in voluntary movements and in the reception of impressions from without, depends upon the motor and sensory branches of the anterior and posterior portions of the cerebro spinal system of nerves. The relation of these nerve-fibres in the different segments of the spinal cord, with their association and co-ordination in the medulla oblongata supply the conditions for the nice and varied developments of the reflex action of the excito-motor system.

But the phenomena or exhibitions of the reflex functions of the spinal cord cannot be identified with the manifestations of the reciprocal relations of the capillary plexus and the ganglionic nerves. The sensations with voluntary and reflex movements are not implicated in the close relations and mutual dependencies of the organic system of nerves and the network of nerve fibres and ganglia intermixed with the capillaries. It is to this intricate association of parts and functions that I wish to direct attention as affording an explanation of the effects of remedies, poisons and various other agencies, which operate through the nervous system upon the physical organization.

The recognized reciprocity between the external and internal or peripheral and central nervous developments indicates an intimate link of connection, and the legitimate deductions from clinical observation have been fully confirmed by the facts of experimental inquiry, so that a satisfactory explanation is afforded of the source of disorder and the means of relief in diseases involving the nerve centres.

However heterodoxical it may appear, general derangement may have local effects; and circumscribed lesions may lead to general results, which demand corresponding means of treatment by topical and constitutional measures.

The measures to be adopted for the relief of affections involving the nervous system, whether included in the class of nervous diseases or otherwise recognized in nosology, should operate upon the excito-dynamic nerve-centres, and may be applied internally so as to be conveyed into the system by absorption, or externally so as to produce a revulsive effect, or again in the form of subcutaneous injections so as to influence the peripheral distribution of nerves, or by inhalation.

The potency of the cold shower bath, electricity, and sudden mental impressions, in effecting important modifications in some forms of nervous diseases is generally recognized, and the recent triumphs of hypodermic applications, not only for the relief of pain but for the correction of molecular derangements, opens up the way for a more extended and systematic use of remedies addressed especially to restoring the equilibrium of nerve power. A very recent application of the anæsthetic inhalations for their remedial effects, independent of rendering the subjects insensible to the pain of surgical operations, affords a clue to the mode of reaching this source of trouble, and a special use of nitrite of amyl for the relaxation of the irregular contractions of

the womb, is among the most important results attained in any department of medical practice.

It is not within the sphere of the present undertaking to enter into the details of treatment for different disorders of the nervous system, and I would simply inculcate the general principle which should guide the practitioner in addressing his remedies to the relief of the pathological states of the nerve centres, so as to place nervous therapeutics on a trustworthy basis. The periodical and irregular exhibitions of nervous disturbance involve the most intricate etiological conditions in the history of the pathology of this class of diseases. Why the cause should be operative at one time and not manifested at another, is only capable of explanation upon the basis of an accumulation of energy which leads as it were to an explosion, with a capacity of reproduction at certain intervals or at indefinite and irregular periods. A consideration of the periodicity of intermittents, though not nosologically in the class of nervous diseases, satisfies me that a peculiar capacity of the nervous system renders latent the efficient cause of trouble, until its constituent elements shall accumulate to the extent of developing a paroxysm or rigor, and can only be accounted for by the changes in the dynamic attribute of the nerve centres.

The same holds in regard to epilepsy, and the calm which is observed between the convulsions is not in any sense an absence of the disturbing cause, but an occasion for its gradual development until it shall have reached a force that breaks forth in the paroxysm which is *sui generis*, and partakes in the same subject for the most part of similar disturbance in each repetition.

Some cases recur with considerable regularity in the intervals, while others observe no fixed period, but a singular characteristic is that individuals are found that are only at-

tacked at night, giving additional confirmation to the doctrine of the accumulation and explosion being favored by certain circumstances in the given case. The charge becoming completed there is a forcible eruption of the excitodynamic energy of the nerve centres.

The measures appropriate for the treatment of epilepsy demand special consideration, and if it be possible to free the therapeutics of this graver malady of the empiricism which has marked all the curative applications up to the present time, it will be an advance of no mean importance. The vague notions of remedies for epilepsy which have taken possession of the minds of all classes have their origin in the utter uncertainty as to the nature of the affection and ignorance of the exact location of the disturbance.

Pathologists have, for the most part, referred the seat of disease to the brain, and that this organ is involved in the disorder there can be no doubt, yet the effect should not be confounded with the cause, in the derangements of the nervous system, when different portions of it are implicated, as in the general convulsions which are a prominent factor of this disease. It is true that congenital cases may have their origin in some cerebral defect, as other result from injuries to that organ, but by far the greater number of cases of epilepsy spring from some remote irritation which is propagated through the nervous system to the brain, and thence extends its morbific emanations through the cerebro-spinal nerves to the general organization. In the instances of remote local affections involving the peripheral nerves and thus developing epilepsy, it is not correct to locate the seat of the disease in the brain, and the rare cases of amputation of such parts proving a radical cure of the epilepsy, demonstrate conclusively that the seat of the disease is not invariably in the brain, and hence it should not be recog-

nized as a disease of this organ. Autopsic investigation "shows that it is not connected with any peculiar organic derangement of the brain," and experiments upon living animals lead to the conviction of some that "the seat of the disease is not in the cerebral lobes, but in the medulla oblongata, pons varolii or the upper part of the spinal cord, and that the convulsion is a reflex action of these centres provoked by excitation from without them." The epileptic aura tends to favor the peripheral origin in some cases of epilepsy. "When the sensation reaches the head or the epigastrium, if this lie in its route, there is an immediate loss of consciousness and the patient remembers no more. At the moment of falling he is seized with general convulsions, and the duration of the paroxysm varies from a few moments to many hours." These violent muscular perturbations are only the commotions of the waves under the disturbing force of the winds, which come from the tempest in the nervous system, and soon subside when the cyclone has exhausted itself, leaving the body weak and the mind stupefied for a considerable period.

With the lights of physiological and pathological experiments as to the mutual reactions of the different departments of the nervous distribution and reciprocal influence of the peripheral nerves and internal nerve centres, I am well assured that the seat of epilepsy pertains to the excitodynamic element of the nervous system, and should not be referred directly either to the brain or the spinal cord as its origin. The multiplicity of the causes which produce this disturbance confirms this conviction; and occasional relief afforded by correcting the trouble which has been the source of the convulsions, serves to rid this position of the doubts that encircle other theories of the nature of epilepsy. The discovery of any sources of irritation is of paramount

importance, and by correcting the emanations from these to the nerve centres, there is a good prospect of effecting a cure of the disease.

The doctrine of inhibition through the "arrest of the exchanges," gives the real clue to its therapeutics by the various agents addressed to the excito-dynamic nerves.

It was incontrovertibly established long since that "an influence proceeds from some external point in special relation with the nervous centre, exciting the epileptic paroxysm, even though not sensible to the patient," and the recent developments from the local applications of chloroform upon the parts corresponding to the distribution of nerves dependent upon the surface to which the anaesthetic has been applied, or in correlation with the same, affords a guarantee for controlling the excitability of the nerves and contractility of muscles implicated in epilepsy.

"The existence of such spots may be known by the production of a fit by pressure or by means of strong galvanic excitation, or by cold, or by the application of a sponge wet with hot water, and these measures may be employed in searching for them in various parts of the body."

Independent of all local applications, and subsequent to the use of remedies for the correction of the special causes of epilepsy, a general treatment addressed to the nervous system is indicated, and for this object agents should be employed that may operate as alterants and tonics to corroborate the vital forces. My personal observation warrants the recommendation of the internal use of the spirits of turpentine uninterruptedly until some of its specific effects as an irritant of the mucous membranes or stranguary, may be presented. After this, strychnine in doses of one-fiftieth of a grain three or four times a day, with a gradual increase until one-sixteenth of a grain is reached, should be main-

tained for at least one month, and for a longer period, in cases of long standing. The cold shower bath in connection with this latter remedy has been resorted to advantageously; and induced currents of electricity have proved useful. The entire armory of the *materia medica* becomes at last only different steps in attaining the end of correcting the deviation of the nerve centres from the normal performance of their functions. All the emetics, diaphoretics, purgatives, etc., which produce their separate and appropriate influences upon distinct divisions of the complex whole, tend at last to bring about an equilibrium in the action of the various parts of the system, and thus by restoring tone to the several functions, establish the normality of the nerve centres. The nerve force is the *sine qua non* of all vital forces, and it must be the prime consideration of any therapeutic proceeding to reach ultimately the correction of all derangements of the nerve centres.

The fountain head of energy for all the functions lies in the nerve centres; and by controlling the emanations from this source of power the vital forces will be propagated with regularity and uniformity to all the remote parts of the physical organization, and it is to this we must look for the cure of diseases.

The means, then, to be adopted for averting injurious impressions upon the nerve centres, and the measures to be used for the correction of their derangements, make up the whole prophylactic combination of hygiene, and include all therapeutic agency in the treatment of diseases, let the details be varied as they may. Rigid clinical observation should reveal the source of the disturbances in the physical organization, and the proper means of correcting them by regimen and medication.

NOTE.—In view of the delay in publication, and of the circumstances connected with this paper, it is proper to state that the article was written more than two years ago, to be submitted to the Imperial Academy of Brussels, which offered a prize on this subject. But upon being sent to Dr. Wilson, the American Consul at that place, with instructions to return it, if essays in the English language were not received for the competition, it was remitted by him with a note informing me that articles in English were not accepted for consideration; and though it failed to accomplish the aim of its preparation, it was hoped that my labor would be utilized by laying the paper before the Medical Association of Georgia.

It is due to the history of developments connected with the views presented in regard to epilepsy, to state that I had not seen or heard anything respecting the theory of Hughlings Jackson when the paper was presented to the Association, and hence no reference was made to the similarity of our views and the correspondence in our solutions of the intricate problem of the causation of this intermittent nervous disease.

Even now I have only received a statement at second hand through Gowers, as reported by Dr. Floyd S. Crego, in the Buffalo Medical and Surgical Journal of July, 1884. This theory holds that the phenomena of epilepsy are all explained by a discharging lesion of the cells of the gray matter, and that the disease affects the motor centres, and does not often have its primary seat in the medulla. "The nerve cells are likened to so many Leyden jars which generate the electricity. Thus the explosion is due to a sudden diminution of resistance by which the pent-up nerve force is released, thus causing the epileptic phenomena."

The views of experimental physiologists as to the functions of the different portions of the nervous system have been materially modified by the recent experiments of Mendelssohn upon frogs, demonstrating that when the anterior columns of the spinal cord are irritated, "the motion ensuing in the extremities made its appearance far more quickly than was the case when he irritated the posterior columns."

It is a recognized fact, that motion induced by irritation of the posterior columns belongs to the reflex order; and motion being produced more promptly in the muscles of the extremities by irritation of the anterior columns than from that of the posterior columns, proves conclusively the direct excitability of the former, so that this important point may be considered as established.

A dynamic element is proved to exist in the direct operation of the nerve power, in its normal and abnormal state, throughout the organism and those interested in understanding the excito-dynamic property of the

nervous system as related to the great nerve centres, are referred to the results of these experiments.

It has been of late a refuge for all who found any difficulty in locating a nervous disorder, to attribute the disturbance to some reflex irritation, and it is not only Dr. Beard that makes this mantle cover a multitude of sins which lie at the door of excitation in a direct channel of the nerve centres, but numerous writers of more fame as neurologists have fallen into the same error. But upon the principle of exclusion we must eventually eliminate the theories of disease which are based upon misconceptions of primordial and elementary disturbances; and by investigating not only the physiological and pathological modifications, but the causative influences that are at work for the development of disease, a true explanation of the abnormal phenomena shall be reached. That many derangements, not now included in the neuroses, will be found largely dependent upon fundamental impairment of the nerve power, is almost certain, from the light recently shed upon the intimate relations of the peripheral nerve-fibrils and their ganglionic developments to the capillaries. It is to this link of communication between the various tissues and the internal nerve centres that disorders of a functional nature are due; and doubtless many, if not all the organic changes, may be traced to impressions, primarily upon the minute ramifications of the nerves in such parts. The point made and insisted upon, is, that the sequences in most cases are independent of the recognized reflex functions of the nervous system, and thus demand a solution distinct from that proposed by the authors of the books on the functions of the nerve in health and disease.

This inquiry is based upon observations and investigations extending through many years; inaugurated so long ago as 1855, in a paper upon "a criterion for the use of stimulants," laid before the South Carolina Medical Association. It was further discussed in 1858, through an article on "dynamoscopy" for the American Journal of Medical Science.

In 1860, an essay upon the "correlation of the nerves and capillaries with the internal organs" was presented to the South Carolina Medical Association. In "the outlook of medicine and surgery" which appeared in some numbers of the Atlanta Medical Register during the past year, I referred especially to the nerve agency in diseases.

In the March number of Gaillaïrd's Journal for the current year, I presented illustrations of "medication through superficial and deep seated tissue," in which the nerve element was prominent. And finally the theory of an excito-dynamic function of the nerves was fully discussed in a series of elaborate propositions, entitled "The unknown factor in the equa-

tion of the nervous system," indicating "the action of medicine on the cure of diseases," just published in the Philadelphia Medical and Surgical Reporter.

Throughout these investigations, I have sought to demonstrate the operation of a definite nerve element, concerned in the development of vital force and its impairment, and giving a solution of the problem of pathology and therapeutics, which is now submitted for consideration.

I trust that intelligent criticism may detect the error, if such exist, in the deductions from facts; or may confirm the inferences, if correct, from a clinical experience of more than a quarter of a century. This appeal to the matured judgment of the profession must lead to a satisfactory decision.

Alvarene Shantz from
Trans. Med. Soc. of La 1883
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